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A preliminary survey of microfungal flora of pine leaf litter in Thailand*

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Summary

The microfungal flora of leaf litter of pines planted at the Suwan Farm of Kasetsart University in Nakhon Ratchasima Prov., Thailand was studied in relation to needle decay by the washing method. The distribution pattern of fungal species in the leaf litter of the tropical pine plantation was very similar to that found in temperate pine forests by other workers. The primary saprophytes occurred most frequently on freshly fallen needles, and the frequency of major species of secondary colonizers increased with needle decay. However, a considerable number of the species observed were characteristic of hot climates and are not usually found in the leaf litter of temperate pine forests.

Introduction

This is the first report on microfungal flora of pine leaf litter in the tropics in relation to needle decay. Pines are originally native to the northern hemisphere and common trees grow in regions with a cool climate, but several pines grow well in the subtropics and tropics (Farjon, 1984). Data on microfungal flora of pine leaf litter regarding the fungal succession involved in the decay of fallen needles have been obtained in the forests of temperate regions. Only one study, by Tokumasu (1985), deals with the microfungal flora of decaying pine needles in the island of Kitaiōjima, Japan, which is characterized by a subtropical climate.

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Materials and Methods

Description of the habitat

Suwan Farm of Kasetsart University in Nakhno Ratchasima Prov. is located about 155km northeast of Bangkok and is located at 14°05'N latitude, 101°E longitude, and 360m above sea level. The area is characterized by a tropical monsoon climate; the rainy season starts in May and ends in October. Annual precipitation ranges between 700 and 1,200 mm in normal years and the mean annual temperature is about 25°C.

Sample collection

The leaf litter samples were collected by Manoch and Tubaki in late November, 1981 in five plots under clusters of three pine species which were planted in 1966, i.e. one plot under *Pinus caribaea* Morelet var. *hondurensis* Barr. & Golf, two under *P. elliottii* Engelm., and also two plots under *P. merkusii* Jungh & De Vries. A small amount of leaf litter which contained decayed needles at various stages was collected in each plot, kept in a paper bag, and taken to the laboratory of Kasetsart University.

Fungal analysis

For fungal analysis each sample was divided into three needle groups based on the external appearance (mainly color and collapse of leaf mesophyll) and state of decomposition, as follows: freshly fallen, relatively undecomposed brown needles (BN), partly discolored needles (PN), and fragments of relatively decomposed grayish needles (GN). Ten single needles derived from ten different needle pairs were sampled from the BN and PN groups respectively. A 7 cm piece was cut from each needle and ten such pieces were washed, dried, and plated on 1/2 corn meal agar medium (Tokumasu, 1978). The plates were incubated on the bench of the laboratory and examined microscopically four time at intervals of a week. In the case of the GN group, ten needle fragments approximately 7 cm in length were chosen and processed as described previously.

Results and discussion

Table 1 gives a list of the fungi recorded in this survey and of kinds of pine leaf litter on which individual fungi occurred. Table 2 shows the percentage frequency of occurrence of each fungus in the individual needle group.

There were few differences in the number of fungi recorded between the litter materials of three pines, though the sample size from *P. caribaea* var. *hondurensis* was only half as large as that from the other two species. Seven species were recorded from only one plot, but no species occurred abundantly in all the plots. Two species, *Thozetella tocklaiensis* (Agnihothrudu) Pirozynski & Hodges and *Pestalotiopsis* sp., occurred abundantly in one plot of *P. elliottii* but in small amounts in the other plots. However, it

Table 1. Fungi recorded from the leaf litter of three pine species

Fungal species	Pine species		
	P. merkusii	*P. elliottii*	*P. caribaea*
Absidia cylindrospora Hagem	−	+	+
Acremonium spp.	+	+	+
Aspergillus foetidus (Nakazawa) Thom & Raper	−	+	+
Aureobasidium spp.	+	+	+
Beltrania rhombica Penzig	+	+	+
Chalara cylindrosperma (Corda) Hughes	+	+	+
Chloridium virescens (Persoon ex Preuss) Gams & Holubová-Jechová var. *caudigerum*	−	−	+
Choanephora cucuribitarum (Berkeley & Pavenel) Thaxter	+	+	+
Cladosporium colocasiae Sawada	−	−	+
Cladosporium spp.	+	+	+
Curvularia pallescens Boedijn	+	+	+
Dactylaria sp.	−	+	−
Endophragmiella boewei (Crane) Hughes	+	+	+
Fusarium spp.	+	+	+
Gliocladium roseum Bainier	+	+	+
Gyrothrix podosperma (Corda) Rabenhorst	+	+	+
Idriella sp.	+	−	+
Mariannaea elegans Samson var. *elegans*	+	+	−
Monacrosporium sp.	+	+	+
Monodictys castaneae (Wallroth) Hughes	−	−	+
Mucor sp.	+	+	+
Myrothecium sp.	+	−	−
Penicillium spp.	+	+	+
Pestalotiopsis sp.	−	+	+
Phialophora sp.	+	+	−
Pleurophragmium parvispora (Preuss) Holubová-Jechová	+	+	−
Scolecobasidium tropicum Matsushima	+	+	−
Stenella spp.	+	+	+
Thozetella tocklaiensis (Aghnihothrudu) Pirozynski & Hodges	+	+	−
Trichoderma koningii Oudemans	+	+	+
Verticillium sp.	+	−	−
Unidentified 1.	−	+	+
Unidentified 2.	−	−	+

+: recorded, −: not recorded.

appeared that there was no significant difference in the composition of the microfungal flora occurring commonly and frequently between the leaf litters of different pines. A similar tendency has been observed in Japan by Tokumasu (1978), who compared five microfungal floras of leaf litter under clusters of pines of different species at Sugadaira and found close similarities in the composition of the species occurring commonly and frequently in the five floras. These findings suggest that the composition of saprophytic fungi involved in needle decay is more strongly affected by climatic conditions than by differences in the species of pine.

As shown in Table 2, *Cladosporium* spp., which were very common in this habitat,

Table 2. Percentage frequencies of occurrence* of fungi in three groups of decayed needles

Fungal species	Needle group**		
	BN	PN	GN
Cladosporium spp.	94	86	66
Trichoderma koningii Oudemans	90	98	96
Fusarium spp.	54	70	80
Aureobasidium spp.	40	12	8
Endophragmiella boewei (Crane) Hughes	38	34	42
Chalara cylindrosperma (Corda) Hughes	34	10	10
Penicillium spp.	26	2	12
Beltrania rhombica Penzig	22	16	4
Stenella spp.	18	34	22
Pestalotiopsis sp.	16	8	4
Monacrosporium sp.	14	20	10
Curvularia pallescens Boedijn	10	4	4
Mucor spp.	10	16	12
Thozetella tocklaiensis (Aghnihothrudu) Pirozinski & Hodges	8	16	10
Acremonium spp.	6	8	10
Pleurophragmium parvispora (Preuss) Holubová-Jechová	6	4	4
Idriella sp.	6	0	0
Phialophora sp.	4	2	2
Absidia cylindrospora Hagem	2	0	4
Chloridium virescens (Persoon ex Preuss) Gams & Holubová-Jechová var. *caudigerum*	2	0	0
Cladosporium colocasiae Sawada	2	0	0
Dactylaria sp.	2	0	0
Gliocladium roseum Bainer	2	4	6
Monodictys castaneae (Wallroth) Hughes	2	0	0
Myrothecium sp.	2	2	0
Scolecobasidium tropicum Matsushima	2	6	6
Unidentified 1	2	0	0
Gyrothrix podosperma (Corda) Rabenhorst	0	22	28
Choanephora cucurbitarum (Berkeley & Pavenel) Thaxter	0	2	12
Mariananaea elegans Samson var. *elegans*	0	2	10
Aspergillus foetidus (Nakazawa) Thom & Raper	0	2	2
Verticillium sp.	0	2	0
Unidentified 2	0	2	0

* Fifty needles per needle group were examined.

** BN: freshly fallen, relative undecomposed brown needles, PN: partly discolored needles, GN: fragments of relatively decomposed grayish needles.

occurred with a maximum frequency in the BN group and with a minimum frequency in the GN group. Of the species occurring frequently in the brown needle group, *Aureobasidium* spp., *Chalara cylindrosperma* (Corda) Hughes, and *Beltrania rhombica* Penzig showed a substantially similar distribution pattern to *Cladosporium* spp. The genera *Cladosporium* and *Aureobasidium* include members of common primary saprophytes (Hudson, 1968; Ellis, 1971). Because most species of these genera which were found in this study showed a maximum frequency in the BN group, they may be considered common

primary saprophytes. *Beltrania rhombica* has been recorded from dead leaves of various tropical plants (Ellis, 1971) and also as one of the first colonizers of freshly fallen leaves of *Gymnosporia emarginata* Laws. in India (Subramanian and Vittal, 1980). Thus the fungal group with such a distribution pattern appears to consist of both primary saprophytes and some secondary ones; the former mainly invade senescent needles remaining on the trees, and the latter are among the first colonizers of freshly fallen needles.

Fusarium spp. showed a different distribution pattern. It also occurred frequently in the BN group, but even more frequently in the PN group, and showed a maximum frequency in the GN group. A similar pattern was observed with *Trichoderma koningii* Oudemans. These species are well-known as fast-growing soil fungi, and their distribution pattern may depend on microclimatic conditions, especially on the humidity in the leaf litter.

Endophragmiella boewei (Crane) Hughes, a species occurring frequently in all the needle groups, appeared to form a dematiaceous hyphal network on the surface of the fallen needles (Kendrick and Burges, 1962). Various fungi with a similar habit have been observed in the leaf litter of temperate pine forests (Kendrick and Burges, 1962; Tubaki and Saito, 1969; Lehman and Hudson, 1977; Tokumasu, 1978; Micthel and Millar, 1978; Soma and Saito, 1979). However, this species has not been recorded as having such a habit. This fungus was first observed on decayed plant materials from a cedar swamp in Illinois, U.S.A. (Crane, 1972), and then it was found on dead leaves and twigs of conifers in Japan and Taiwan by Matsushima (1975, 1980). This fungus, therefore, appears to be widely distributed on dead leaves of various conifers. As *Gyrothrix podosperma* (Corda) Rabenhorst was only identified in the PN and GN groups, this species appeared to be a typical secondary saprophyte.

The fungi recorded included several species whose distribution appears to be restricted or closely related to hot climatic conditions. These include *B. rhombica* (Ellis, 1971), *Choanephora cucurbitarum* (Berkeley & Pavenel) Thaxter (Hawksworth et al., 1983), *Cladosporium colocasiae* Sawada (Ellis, 1971), *Curvularia pallescens* Boedijn (Ellis, 1971), and *Scolecobasidium tropicum* Matsushima (Matsushima, 1983), and presumably all of them were recorded the first time from pine leaf litter.

Tokumasu (1985) surveyed the fungal flora of pine leaf litter collected from Kitaiō-jima island, which is characterized by a humid, subtropical climate. He found that the species occurring commonly or frequently in that litter included several fungi not usually observed in the leaf litter of temperate pines, such as *Thozetella cristata* Pirozynski & Hodges, *Dactylaria* sp., and *Sporothrix* sp. He also noted that several fungi recorded frequently in warm climates were included in the list of species isolated. A similar tendency was also noted in the results of the present survey, though most of the charac teristic species were different from those recorded in Kitaiōjima. On the other hand, the microfungal flora of Suwan Farm was different from that of Kitaiōjima in the

presence of some common primary saprophytes and a distinct surface colonizer that formed a dematiaceous hyphal network. Thus, the results of the present survey suggest that the type of fungal succession associated with needle decay in the area studied is probably very similar to that in temperate regions.

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摘　　要

タイ国マツ林リーフリターの微小菌類相（予報）

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タイ国の Nakhon Ratchasima 県にある Kasetsart 大学 Suwan 農場に植栽されていたマツのリーフリターの微小菌類相を洗浄法で調査し，葉の分解程度と菌の分布との関係を検討した．熱帯マツ林のリーフリターで見られた菌の分布パターンは温帯マツ林リーフリターの分布パターンとよく似ていた．すなわち，様々な植物の枯死器官上に素速く広がる腐生菌が落葉後間も無いと思われる葉で最も多出し，落葉後に侵入する腐生菌の多くは腐朽の進んだ葉ほど頻度高く出現した．出現菌には暑い気候の地域に多く，温帯では稀産な種が含れていた．